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S. Biggar attended a MODIS Emissive Workshop at the University of Miami from February 2-3. Biggar and K. Thome completed their papers based on presentations at the Newrad'97 Meeting and sent the papers to Metrologia for inclusion in the special issue on Newrad'97. Thome attended the JPL Airborne Workshop January 12-14 where he presented a paper on the use of dark and bright targets for the vicarious calibration of AVIRIS. The bright-target results were based upon AVIRIS data collected over Lunar Lake during the June 1997 joint campaign. J. Smith and P. Nandy prepared papers for the IGARSS'98 meeting to be held in July in Seattle. Smith's paper compares the at-sensor radiances predicted by the reflectance-based and irradiance-based approaches from data collected during the June 1997 campaign to Lunar Lake. The data for these comparisons were collected with the recently-developed diffuse-to-global meter and the paper also compares optical depths obtained from diffuse-to-global measurements with those from a solar radiometer. Nandy's paper covers the calibration and validation of the BRF camera system.

E. Zalewski completed a preliminary design for a new airborne radiometer and presented this design at an informal review on February 18. The system's construction and initial use are prompted by work for SeaWiFS, but the system is planned to be used for calibration of the ocean-color bands of MODIS. The principal components are a telescope, fiber optics, filters, detectors, amplifiers and data acquisition system. The conceptual design for the telescope mounting system will use a Zeiss-type camera mount based on availability of aircraft. Zalewski also presented the conceptual design of an on-board calibration system based on the preliminary specifications for the telescope. P. Nandy presented information about aircraft mounts and possible aircraft companies, prices, mounting and stabilization systems, and availabilities/flight-ranges. Zalewski began procurement of long-lead items and several of the key components such as the telescope, fiber optics, detectors, amplifiers, relays, precision resistors and the HP data acquisition system. Landiscor (Phoenix-based aerial survey company) loaned the RSG three-airborne camera mounts for testing and development of a custom mounting-interface plate for Zeiss-type camera ports. Nandy investigated inertial gyroscopes with 1/2-degree precision.

Nandy obtained a mounting bracket to hold an Exotech radiometer in a light aircraft from MODIS team member, A. Huete. Nandy modified this mount to include a clinometer, video camera, and magnetometer and the mount and radiometer were flown on January 6 and 7 at Railroad Valley Playa. Data were collected along 11, 12-km long flight lines in the along-track direction of Landsat-5. The flight lines were approximately 500 m apart and the data were to be used to test techniques for calibrating large-footprint systems like MODIS. Unfortunately, poor weather on both days prevented the aircraft data from being used for calibration purposes, but B. Magi and Nandy developed software to generate a rasterized image from the data and the results qualitatively match those from a recent HRV image of the area.

S. Biggar made measurements and modifications to our 40" SIS examining the warm up / cool down behavior in an attempt to explain results from measurements made at NRL last

November. The results of the current measurements indicate that the Labsphere power supplies run in a quasi- constant current mode but the output from the supplies decreases several tenths of a percent for a couple of hours after start up. Also, if the thermal environment of the SIS changes, the voltage required to maintain the output changes and the power supply current also changes (it should not). If we power one lamp with a precise constant current power supply, the voltage required to maintain that current goes up several tenths of a percent when additional lamps are lit. When the SIS is stable with 10 lamps lit, the output of a single lamp changes for up to an hour after the other 9 are turned off. Turning off power supplies affects the output of a single lamp even though the other lamps are off. These results all have implications in how we characterize our cross- calibration radiometers (CCRs) and other equipment. We also need to carefully evaluate the use of any Labsphere SIS for instrument radiometric calibration purposes.

A. Ahmad, Biggar, R. Kingston, M. Mienko worked to find/fix a problem with the Optronic monochromator and found that the system's computer was failing due to both GPIB and serial problems. Kingston configured a new computer with the existing GPIB, video, HD, and ethernet to allow both GPIB and serial communication to be used with the monochromator. C. Burkhart sealed light leaks in the calibration laboratory and under doors leading between the laboratories in order to reduce stray light problems. E. Nelson and Kingston modified the wiring and connections for the monochromator to give more repeatable and reliable power to both the quartz halogen lamp and the glower (IR). Biggar implemented a new HP34970A to study the stability of the monochromator's source and found it to be stable in electrical power to about 1 part in 2000. The software developed by Biggar to operate this DVM is modular in nature so as to allow its use in the blacklab, calibration laboratory, and with Zalewski's airborne radiometer. While working with ASTER team member H. Kieffer's filters from his lunar characterization work, Biggar determined that the InSb detector in the monochromator needs to run for three hours once the dewar and detector have cooled the system before beginning measurements.

Biggar made plans for characterizing spectroradiometers from K. Carder's group at the University of South Florida and Burkhart machined a mount for this radiometer to measure its FOV. Biggar worked with R. Stewart and C. Cattral from K. Carder's group to characterize several of the spectroradiometers they use for their ocean-color work with MODIS. FOV measurements were made using our calibration laboratory's collimator and radiometric calibration and linearity measurements were done using the 40" SIS.

Zalewski received several sets of the custom-made ion-assisted deposition filters from Barr. These filters are similar to three of the MODIS filters in the NIR region. The intended application for these filters is to outfit both the VINR and SWIR ultra-stable radiometers with the same filters in the region of spectral overlap of the Si and InSb photodiode responsivities. This will enable cross-comparison of our two ultra-stable instruments. Zalewski began measurements to characterize both the in-band and out-of-band transmission of the Barr filters.

J. Chowdhury and Zalewski began to develop electronics for feedback- stabilized incandescent sources based on designs from Zalewski. Tests of an HP power supply control of our 6-inch spherical integrating source were used for preliminary determination of the electronic parameters. Chowdhury tested a preliminary feedback control circuit, designed by Zalewski, and Chowdhury also set up of a test source and detector system based on designs from Zalewski and using diode and lamp holders machined by Burkhart. Zalewski is also creating a detailed plan to implement feedback control of our 6-inch, and then 40-inch, sources.

Biggar continued developing software for the blacklab and began assembling our various codes for consistent use with gpib, unidex, and HP subroutines by using appropriate library calls. He determined that problems we have with controlling our stages in the laboratory are due to problems with communication to the stage controller. Biggar added further error checking to improve the communication and is testing these modifications. Testing of the software with the HP34970A showed problems so another GPIB connection will be added through our Sun network to control the automated filter wheel, shutter, and chopper. Ahmad, Biggar, and Mienko began developing software for this equipment that will allow the automation of our blacklab measurements. Biggar and Mienko began implementing the automated filter wheel. Mienko is able to move the wheel using computer control and began attempting to use a GPIB interface rather than serial so we can operate it from either our Sun network or a PC. Burkhart aligned our blacklab stages and laser and installed nonskid pads on the floor to prevent the tables from moving. He realigned the stages in the lab, and he designed and began construction of a mount for an automated filter wheel for the blacklab VNIR radiometer.

Biggar tested the temperature stability of the second VNIR CCR. Biggar and Nelson discussed methods for implementing the second VNIR CCR head in a more portable version of the CCR for possible use in the field or traveling. Biggar and Zalewski began making plans for a possible May round-robin calibration of the MODIS SIS at SBRIS. Burkhart machined alignment rods on the SWIR CCR's tripod mount for better repeatability of the measurements.

K. Scott continues to work on the development of the cross-calibration program. The code that performs the search for suitable calibration sites has been improved to increase the fidelity of the estimated inhomogeneity of the identified sites. Scott reviewed work of other investigators of the cross-calibration technique in preparation for the final data runs. She also collected data on the uncertainties in the cross-calibration technique when using different types of calibration targets. This information will be used in the design of the error module for the cross-calibration program to ensure that all important sources of uncertainty can be studied. The error module is being constructed which will allow users to run a statistical analysis of uncertainties for each cross-calibration performed.

Nandy created algorithms for registering images from the BRF camera to create false-color images. Nandy developed software to 'stitch' multiple images of our 40" SIS into a composite flat-field image. Nandy generated a fourth-order polynomial fit to these data and used the results to examine noise-issues. Ephemeris code developed by Smith was adapted to compute the solar zenith and azimuth angles allowing the BRF data to be viewed in terms of scattering angle. Processing routines were also created to rotate BRF Camera images in and out of the principle solar plane to generate solar plane and 90-degree perpendicular solar plane BRDF data, based on angles generated from a ephemeris program.

The BRF camera was used by Nandy on the January field campaign and data were collected on one day of the campaign to understand the instrument's behavior in extreme cold conditions (-10 degrees C). At these temperatures Nandy found that liquid cooling was not required. Nandy participated in a data collection at the USDA ARS facility in Tucson organized by Landsat-7 Science Team Member, M. S. Moran. Data were collected with the BRF camera and the "iron maiden" BRF instrument throughout the morning for four different reflectance tarpaulins. The camera was also run concurrently with the iron maiden at Ivanpah playa during a campaign held the second week of March. Data were collected for two days with both systems over the playa and an additional day over an 8% reflectance calibration target. The data have been processed from the 8% tarp for both instruments, but a malfunction in the data collection software for the iron maiden prevented

any playa data from being logged. Burkhart repaired the mount for the BRF camera as well as defective/rusted parts of the camera's chilling unit.

Software development for processing diffuse-to-global data continued with Smith developing IDL code to calculate the molecular optical depth using an algorithm proposed in a 1995 issue of Applied Optics. She also added a routine to calculate the inputs for the 6S radiative transfer code needed to predict the at-sensor radiances in the irradiance-based approach. The graphical user interface for the D/G processing software is under construction. Smith is also continuing development of the processing software including on-line instructions for the user. Smith developed IDL software to read and compare instantaneous optical depths from our manual solar radiometer and the D/G.

Smith compared diffuse-to-global instantaneous optical depths to values obtained by our manual solar radiometer. Values from the Lunar Lake campaign in June agree well for the 24th and 25th. The agreement on the 23rd is not as good, but this is not surprising because this was the first day of data collection at Lunar Lake, the first time Smith operated the system, plus the weather was marginal. The results for November 1 from White Sands also agreed well with total instantaneous optical depth differences of around 0.002 for bands 2 thru 8. The difference in band one is approximately 0.005, but the manual solar radiometer has a history of poorer SNR in this band. Smith found some non-linearities in the Langley plots from the diffuse-to-global data in the 610 to 930 nm spectral range. These appear to be due to an incorrect sphere-response correction based on the combination of theoretical, lab and field tests. Smith is investigating these data to determine a better response curve. Measurements from the Lunar Lake trip in June 1997 were used in an irradiance-based scheme to predict the at-sensor radiance for the AVIRIS overpass on June 23. The values were compared to AVIRIS and also to those obtained from the reflectance-based approach. The differences are <11% for the 500 to 900-nm spectral range. There appears to be no systematic differences between the methods. Smith obtained the MAS files for this same date for further comparison. Lopez has began analyzing these data using software provided by L. Gumley from the University of Wisconsin.

Smith collected diffuse-to-global data with S. Schiller from South Dakota State University from March 3-11 at Pinal Air Park, approximately 20 miles north of Tucson. The two collected coincident data using Schiller's nine MFRSR shadowband instruments and the RSG's diffuse-to-global instrument. Schiller provided a copy of his data along with processing software. Smith will process both types of data for comparison. The D/G meter was taken to Ivanpah Playa during the March campaign to collect data for an irradiance-based calibration of Landsat-5 TM. In addition, an experiment was performed to identify the effect of objects near the instrument on the diffuse irradiance measurements. This was accomplished by using a 0.8- by 1.0-m posterboard held at approximately 2 m above the ground. Measurements were taken for three different azimuthal angles and at distances from 1.5 to 8 m from the instrument at approximately 1.5 m increments.

J. LaMarr began searching Landsat-5 TM data of the Tucson area in an attempt to find a local calibration site. This work is primarily for use with Landsat-7 ETM+, but will also be adapted for ASTER. A search of sites that are 4x16, 3x3 and 5x5 pixels based on a minimum, average apparent reflectance of 0.20 in all bands and a maximum percent standard deviation of 1-2% showed several possible candidates at the Asarco Mine complex south of Tucson. LaMarr sent a letter to the general manager of the site explaining our work and asking permission to make measurements at the mines.

LaMarr continued his background research on adjacency effects, both accounting and correcting for the effect. Preliminary indications are that the algorithm developed for MODIS is the easiest to adapt for ASTER and Landsat-7 ETM+. LaMarr contacted E.

Vermote of GSFC about the possibility of using his MODIS code and adapting it for use with ETM+ and ASTER.

A field campaign to Railroad Valley was made January 4-10 for calibration of Landsat-5 TM and SPOTs-1 and -2 HRV. A. Ahmad, W. Barber, B. Magi, P. Nandy, and K. Thome participated in the campaign. Snow covered the site for the January 5 overpass of TM and it was decided not to collect data since the snow did not provide high reflectance in the SWIR and the goal of the data collection was to evaluate the playa surface for calibration purposes in the SWIR. Weather on the other dates was cloudy so no data were collected for calibration purposes. LaMarr organized a field campaign to Railroad Valley Playa for the first week of March and to Ivanpah Playa for the second week. The plans were to calibrate Landsat-5TM twice and SeaWiFS twice as well as test new equipment and data collection methods. Zalewski arranged for the SeaWiFS sensor to view the site with a nadir view. On the trips, we successfully collected data for Landsat-5 TM at Ivanpah and Railroad Valley, but the weather was somewhat marginal at Railroad Valley. Poor weather, prevented us from collecting data for SeaWiFS calibrations. LaMarr and J. McCalmont participated in a field data collection in Tucson that was a joint campaign with Positive Systems, Pima County, and A. Huete's group. LaMarr and McCalmont collected solar radiometer data for the experiment.

The RSG obtained an automated solar radiometer from J. Reagan's group at the University of Arizona. A. Lopez learned the operation of the system and tested it during the diffuse-to-global comparison data collection at Pinal Air Park. The radiometer was also used during both the Railroad Valley and Ivanpah Playa campaigns held in March. Preliminary comparisons between the automated and manual solar radiometers show excellent agreement. Lopez began developing software to simplify the processing of these data.